

Emerging Technologies for Bioethanol Recovery Using Membrane Processes

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Keywords: biomass, ethanol, fermentation, pervaporation, separation

Petroleum is currently used as the starting material for many commodity chemicals and fuels, but the prospect of dwindling oil supplies, reliance on unpredictable oil sources, and the carbon balance of the planet are concerns. Sustainable production of commodity chemicals and biofuels, such as ethanol, using fermentation of waste biomass is a promising alternative process that is renewable and potentially more energy efficient. The efficiency of removing fermentation products from biological media is directly linked to the cost competitiveness of the biomass conversion process. The U.S. Environmental Protection Agency (U.S. EPA)/NRMRL Pervaporation Team is working to develop more efficient technologies to perform these separations with the goal of moving toward economical distributed production of ethanol from biomass available throughout rural America. Pervaporation is a membrane-based process used to separate compounds from a liquid mixture by selective permeation through a membrane into a vacuum permeate stream.

Our research and development activities focus on several aspects of the separation processes to improve separation efficiency: (1) developing membranes for recovery of fermentation products, such as ethanol; (2) developing dehydration membranes for final purification of the products; (3) improving energy recovery during separation processes; (4) linking separation processes to fermentation processes; and (5) investigating feasibility of other separation processes. Our team is currently collaborating with fermentation experts, membrane and other equipment manufacturers, biomass conversion system implementers, and end users on four industry-led, government-funded research projects that focus on these areas. These projects include the following:

1. High-Performance, Low-Cost Pervaporation Modules for Ethanol Extraction: Department of Energy (DOE) Phase II Small Business Innovative Research (SBIR) grant to CeraMem Corporation.
2. Bioethanol Production with Membranes: DOE Phase I SBIR grant to Membrane Technology and Research, Inc.
3. BioSep: A New Ethanol Recovery Technology for Small-Scale Rural Production of Ethanol from Biomass: U.S. Department of Agriculture (USDA)/DOE Biomass Research and Development Initiative Project led by Membrane Technology and Research, Inc.

4. Tactical Bio-Refinery for Forward Fuel Production: Department of Defense (DOD) U.S. Army Phase I Small Business Technology Transfer (STTR) grant to a group of small businesses led by BC International.